p. 2

LUNA 24 REGOLITH BRECCIAS - A POSSIBLE SOURCE OF THE FINE SIZE MATERIAL OF THE LUNA 24 REGOLITH, O.D. Rode, V.I. Vernadsky Instit. of Geochem. and Analytic Chem., Moscow, Russia; M.M. Lindstrom, NASA Johnson Spase Center, Houston, TX. 77058.

We analyzed the regolith breccias from the Luna 24 core. The Luna 24regolith is a mixture of fine and coarse grain materials. The comparable analysis of the grain size distributions, the modal and chemical compositions of the breccias and the regolith from the same levels shows, that the friable slightly litificated breccia with a friable fine grained matrix may be a source of fine grain material of the Luna 24 present day regolith.

Regolith breccia - a second lunar rock forming by a shock lithification of lunar regolith and containing all its component. Regolith breccias are formed from older regolith and may differ from present-day regolith. They may contain very interesting information on the evolution of surface soils.

We analyzed the regolith breccias from the Luna 24 regolith core. As well known the Luna 24 core is mixture of a coarse, immature component and a finer, submature component [1, 2 and oth.]. The investigation of the Luna 24 regolith breccias may give very usefull and important data which can help to understand the forming of the Luna 24 regolith. For our investigations we selected breccias from the enriched in breccias 133 and 165 cm level of the Luna 24 core. We studied the polish thin sections of the breccias themselves and the grain size fractions. For dissagregation we selected two typical regolith breccias from 143 and 160 cm levels and applyed the method describied in [3] using also ultrasonic techniques.The samples were sieved in ethanol. We did a study of modal petrology and chemical compositions of grain fractions (using INAA). The obtained data we compare to the data on the Luna 24 regolith samples from the same levels.

Investigating the thin sections we found out two large groups of regolith breccias which appreciable differ in matrix: 1) group A - friable,very poorly consolidated breccias with matrix consisting of finely comminuted clasts of mineral and containing a little glass, and 2) group B -more compact, porous breccias with dark glass matrix including angular rock and mineral clasts of different sizes. According to the grain size distribution data (presented in table 1) breccia A is considerable more fine grained compared to breccia B and especially to the regolith. Table 2 demonstrates the modal data of the 250-100 and 100-45 µm fractions. The grain fractions of the breccias have very high contents of monomineralic grains; among them pyroxene predominates. Breccia A is more rich in plagioclase than breccia B. In breccia B we observe the increase of glass and lithic fragments (especially mare basalt) compared to breccia A.The agglutinates are nearly absent in the breccias perhaps because of destruction under lithification. Both breccias contain spherules.In the modal analysis of the grain size fractions we can observe the same systematic trends which are peculiary to regolith: the increase of plagioclase and pyroxene and decrease of lithic fragmens with decreasing of particle size.

The chemical composition data show the compositional similarity of the regolith breccias (Table 3). The chemical element distributions in the grain size fractions have the same trends as in regolith samples:with decreasing of grain size the fine fractions become slightly enriched in the feldspathic elements (Na_2O, CaO) and depleted in mafic elements(FeO, Sc). However in the regolith this trend is more strongly marked than in the breccias. It is also necessary to note that the fine fraction of breccia A is more enriched in the feldspathic elements than the regolith from the same level. The similarity of the chemical compositions of both breccias and the regolith shows that all of them are of local origin.

We suggest that breccia A was formed by impact lithification from well developed mature local previous regolith. Now this breccia is one of the possible source of the finest material in present day regoliththat is a result of space weathering of local rocks excavated after breccia A forming.

References: [1] Rode O.D. and Ivanov A.V. (1984) LPS XY, 691;[2] McKay D.S. et al. (1978) Mare Crisium: The View from Luna 24, 125-136;[3] Rode O.D. and Ivanov A.V. (1984) Solar System Res., 18, N1,1-4.

Table 1. The size fractions of Luna 24 regolith and breccia, %

size fraction,	24143,26		24160,26	
µm	regolith	breccia	regolith	breccia
200-370	8.5	0.6	10.6	2.6
100-200	22.3	13.8	22.7	38.3
45-100	24.2	31.1	26.5	24.3
10- 45	33.3	17.9	30.0	19.9
< 10	11.7	36.6	10.2	14.9

LUNA 24 REGOLITH BRECCIAS: Rode O. D. and Lindstrom M.M.

Table 2. Particle types and relative abundances in size fractions (μm) of Luna 24 regolith and breccias.

	24143				24160			
	regolith		breccia		regolith		breccia	
	250-100	100-45	250-100	100-45	250-100	100-45	250-100	100-45
Agglutinat.	2.3	2.2	0.0	0.0	7.4	2.1	2.2	0.0
Breccia reg.	27.1	17.3	8.4	5.6	22.9	12.4	14.9	10.1
Plagioclase	8.4	12.1	16.0	19.8	4.1	6.1	9.0	12.2
Olivine	6.2	3.7	7.7	10.3	5.5	6.6	4.7	3.2
Pyroxene	31.0	44.2	48.8	49.1	30.3	50.1	24.2	35.4
Opaque	3.9	3.8	2.1	2.9	1.0	2.4	5.1	6.3
Glass	5.4	5.3	4.7	5.2	2.0	3.4	18.5	21.2
Spherules	0.5	1.2	1.7	2.6	1.7	1.8	0.9	1.4
Mare basalt	11.7	7.4	3.0	2.1	18.7	9.8	12.0	8.8
Gabbro	2.9	2.5	3.0	0.0	6.2	3.3	4.9	0.0
Others	0.6	0.3	0.6	0.0	0.2	2.0	3.6	1.4

Table 3. Chemical composition of the size fractions of Luna 24 breccia[1] and regolith[2]

	24143				24160			
	breccia/regolith				breccia/regolith			
	200-100	100-45	45-10	<10	200-100	100-45	45-10	<10
Na_2O,%	0.23	0.25	0.28	0.45	0.22	0.22	0.27	0.42
	0.15	0.18	0.18	0.37	0.20	0.18	0.31	0.38
K_2O,%*	<0.06	0.04	<0.11	0.06	<0.10	<0.04	0.05	<0.16
CaO,%	11.0	11.3	11.4	11.4	10.9	10.9	10.7	11.6
	6.0	6.0	6.1	6.7	6.1	6.1	6.5	7.0
FeO,%	19.9	20.4	19.2	15.9	20.3	20.5	18.7	16.0
	22.8	19.6	17.1	14.3	22.6	21.2	20.8	15.4
Sc,ppm	48.9	46.6	42.0	30.3	51.8	50.0	41.4	30.0
	47	46	35	29	59	52	43	30
Cr,ppm	2800	2950	2990	3050	2820	2840	2760	3060
	4100	3800	4000	3100	3900	4200	2800	5500
Co,ppm	54.4	54.3	50.3	45.2	57.0	55.7	49.6	46.3
	50	55	43	44	52	50	50	41
Ni,ppm*	290	217	260	240	240	159	180	740
Sr,ppm*	100	97	<180	180	<190	100	<100	90
Ba,ppm	46	39	<120	65	<80	54	46	49
	40	40	100	100	75	95	95	125
La,ppm	3.02	3.07	2.98	5.03	3.54	3.28	3.58	4.00
	1.9	2.3	4.7	4.9	1.4	2.1	3.5	5.5
Ce,ppm	9.4	10.6	8.4	13.4	9.7	9.9	10.6	11.0
	7.7	17.2	14.1	18.3	6	7	14	20
Sm,ppm*	2.04	2.07	1.89	3.01	2.41	2.26	2.39	2.25
Eu,ppm	0.61	0.64	0.71	0.94	0.62	0.64	0.70	0.88
	0.54	0.51	0.60	0.84	0.61	0.69	0.81	1.1
Tb,ppm	0.51	0.54	0.43	0.77	0.67	0.60	0.60	0.51
	<1	<1	<1	0.9	<1	<1	0.6	0.9
Yb,ppm	1.94	1.99	1.92	2.23	2.29	2.14	2.15	1.93
	1.8	2.3	2.1	2.9	2.1	1.6	2.3	2.5
Th,ppm*	0.63	0.73	0.41	1.39	1.21	0.79	1.14	0.51
Ir,ppm*	8.1	5.1			11	7.4	<9	12
Au,ppm*	26.1	<3.3	<8		6.8	2.7	27.5	7.8

[1]The data of M.M.Lindstrom [2]The data of O.D.Rode *The data only for the breccias